Columbia River Temperature TMDL

Proposals for TMDL Elements

Loading Capacity

Gross Allocations - dams and other sources

Loading Capacity (expressed in terms of temperature)

At each compliance point,

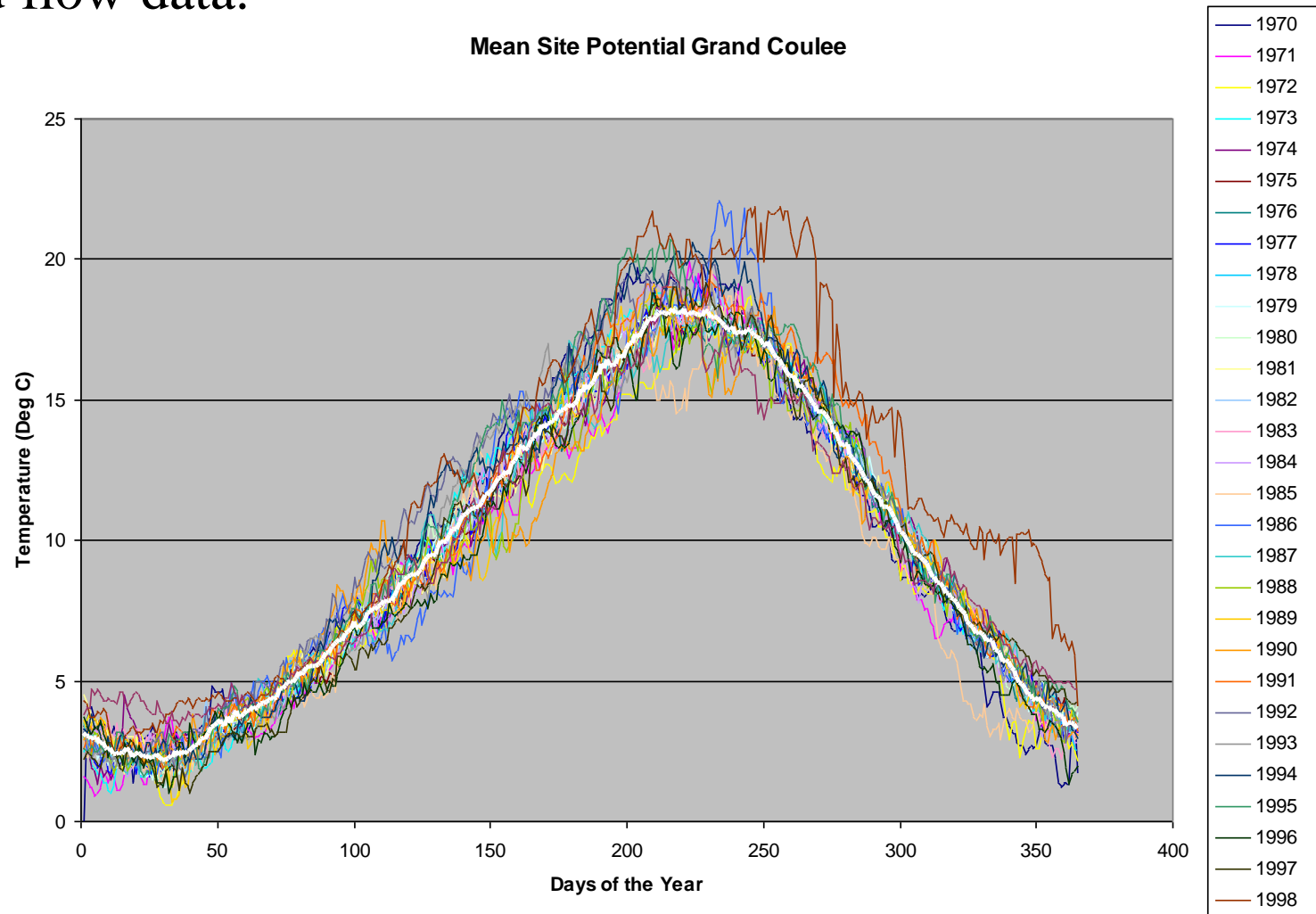**Loading Capacity =**

site potential temperature
+
allowable incremental increase

The site potential temperature varies every day.

The allowable incremental increase also varies, depending on the water quality standards at the compliance point and the site potential temperature on a given day.

To account for this variability we utilize the mean daily site potential temperatures based on 30 years of simulations using actual weather and flow data.

Mean Site Potential Grand Coulee

CUMULATIVE LOADING CAPACITY

Caution:

Upstream increments are less stringent than downstream increments.

Example:

Columbia at Grand Coulee - 0.3 deg C in summer, up to 3 deg C at other times (formula)

Columbia at Bonneville - 0.14 deg C in summer, 1.1 deg C at other times

When temperatures exceed the numeric criteria…

River temperatures cannot exceed the site potential temperature by more than 0.14 ☞C in Columbia River below Priest Rapids (Oregon standards), nor more than 0.30 ☞C above Priest Rapids and in Snake River (Washington standards).

When temperatures are below the numeric criteria…

River temperatures cannot exceed the site potential temperature by more than 1.1 ☞C in Columbia River below Priest Rapids (Washington standards)

Allowing the full increments at Priest Rapids and above results in exceedance of the 0.14 and 1.1 maximum increases below Priest Rapids.

We used RBM-10 to determine uniform allowable incremental increases that could be assigned to all the dams and result in compliance with WQS in the reach below Priest Rapids.

An allowable increase for times when site potential temperature is above criteria and another for when site potential temperature is below criteria.

Conceptual Allocation Table - Coulee (nc=16)

Day	Site Potential	Loading Capacity	Uniform Increment	Increment Allocated to Dam	Increment Allocated to Other Sources	Future Growth
215	17.05	17.20	0.15	0.12	0.02	0.01
218	16.51	16.71	0.15	0.12	0.02	0.01
221	15.92	16.27	0.35	0.32	0.02	0.01
224	15.02	15.37	0.35	0.32	0.02	0.01
227	14.75	15.10	0.35	0.32	0.02	0.01

The Uniform increment in Column 4 is the GROSS ALLOCATION

The TMDL can explicitly allocate the uniform temperature increments between the dam and other lumped sources (point and nonpoint) and future growth at the compliance point.

Since dams are instream structures, operators can only measure their impact on the river by measuring the river itself at the dam location. Therefore, the dam operations will be evaluated using the allowable daily temperature at the dam location (site potential + uniform increment).

We can simplify the table by splitting the 365 daily target temperatures from the easier-to-summarize increments.

For the daily targets, we can list two kinds of targets:

Maximum temperature targets at compliance points

95th percentile site potential temperature + uniform increment

Long term average temperature targets at compliance points

Mean site potential temperature + uniform increment

Table 1:
Loading Capacity (Target Temperatures) at Coulee Tailrace

Day	Mean Target Temperature	Maximum Target Temperature
215	17.20	18.60
218	16.71	18.47
221	16.27	17.85
224	15.37	17.05
227	15.10	16.76

Table 2:
Gross Allocation Table

Time Period	Uniform Increment	Dam Increment	Lumped Sources Increment	Future Growth
Day 180 - 220	0.15	0.12	0.02	0.01
Day 221 – 179	0.35	0.32	0.02	0.01

TECHNICAL ANALYSIS OF ALLOWABLE INCREMENTS

Use process model of site potential condition (RBM10)

Calculate the loading capacity by adding the temperature increment at each compliance point as allowed under the standards. The allowable increment ranges from 0.14 ☞C to over 2 ☞C depending on the river temperature and applicable standard at the compliance point.

Set the river at the standard and continue the simulation downstream.

Determine if the above allocation will exceed the allowable cumulative increase in the Lower Columbia